Deutsches Zentrum
für Luft- und Raumfahrt
German Aerospace Center
Institute of Transportation Systems

Adapt:/Ve

Automated Driving Applications and Technologies for Intelligent Vehicles

Human-Vehicle Integration in automated vehicles

Human Factors Recommendations for Highly Automated Driving

Marc Dziennus
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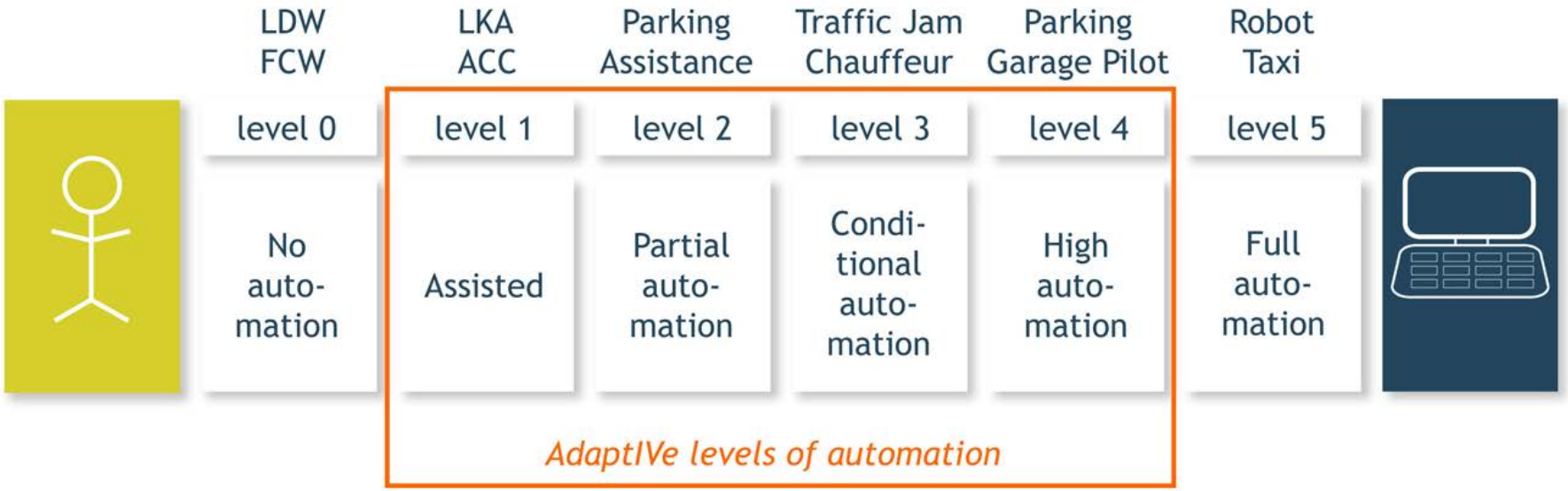
Automated Vehicle Symposium 2016,
San Francisco
16/07/19

// AdaptIVe
Automated Driving

Budget:	25 Million EUR
European Commission:	14,3 Million EUR
Duration:	42 months (January 2014 – June 2017)
Coordinator:	Aria Etemad, Volkswagen Group Research
28 Partner:	France, Germany, Greece, Italy, UK Spain, The Netherlands, Sweden

// Levels of automation in AdaptIVe

SAE



SAE document J3016, "Taxonomy and Definitions for Terms Related to On-Road Automated Motor Vehicles", issued 2014-01-16

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Automated Driving

- Development of new functions on cars and trucks for automated driving
- Research covers several scenarios
- Definition of evaluation methodologies
- Addressing the legal framework

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Sub Project 3 Partners

VOLVO

SP3 Lead

UNIVERSITY OF LEEDS

wivw

VOLVO

Ford

DLR

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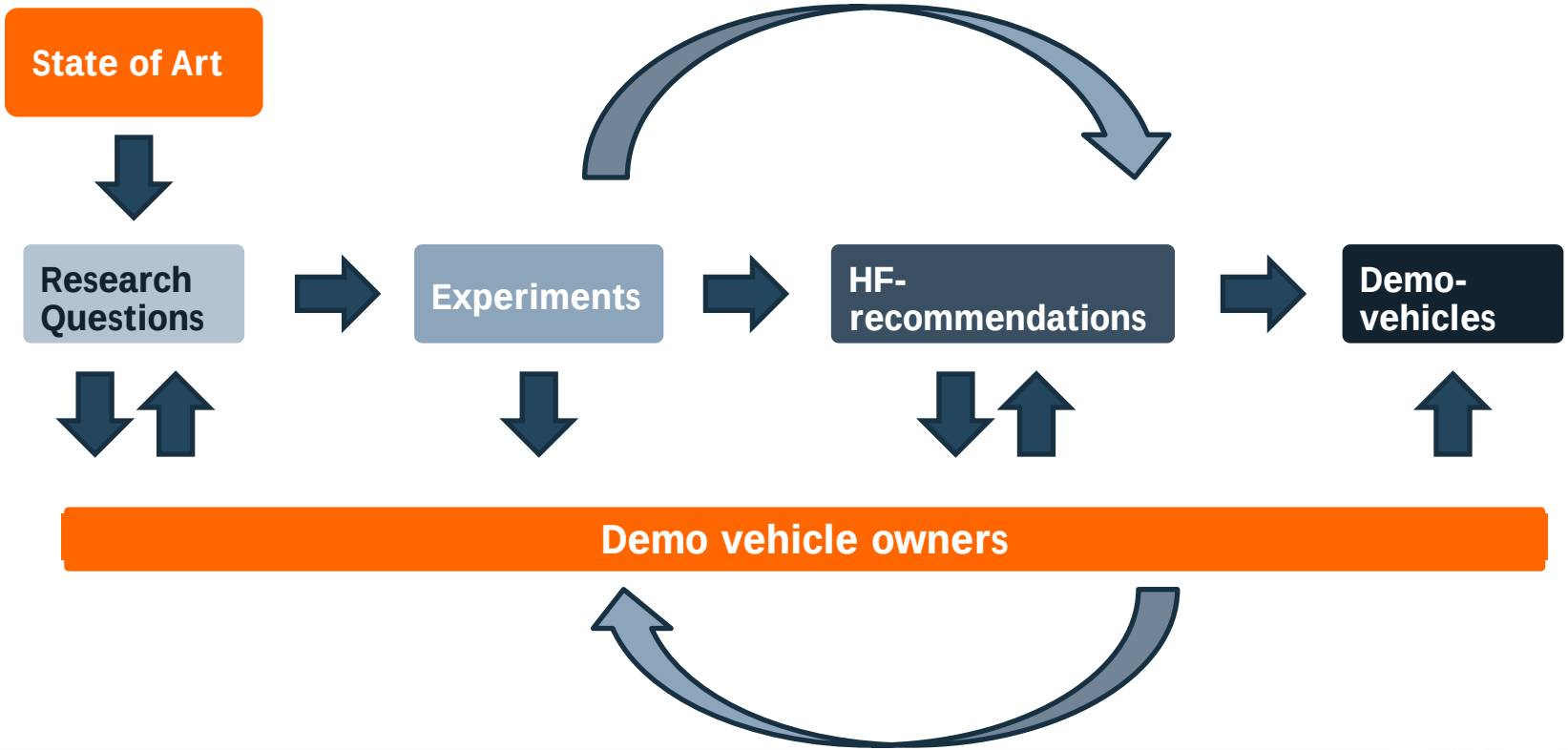
// SP3: Human-Vehicle Integration

- Main goals:
  - Support partners with Human Factors (HF) knowledge
  - Homogenize development by providing HF-recommendations

- Create use cases for development and test of functions
- Collect existing HF-recommendations
- Develop new research questions for Human-Vehicle Integration
- Carry out experiments based on the new research questions
- Create new HF-recommendations

// General workflow in SP3



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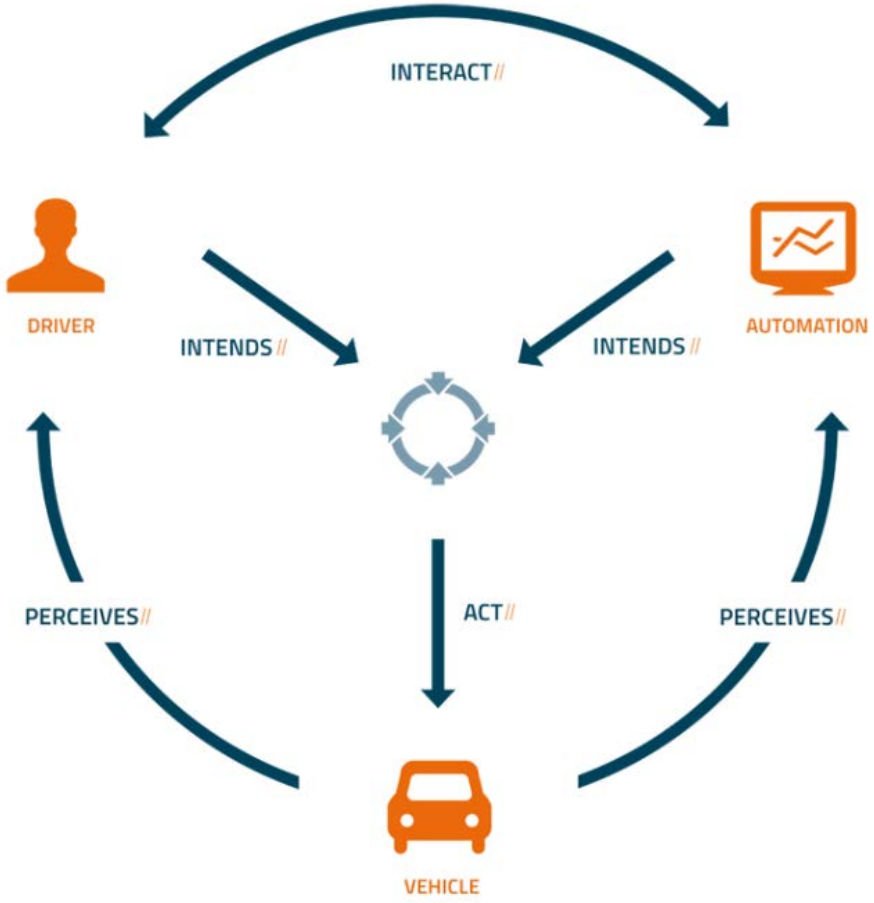
- HMI design for
  - Driver assistance in different automation levels
  - Transition between automated & manual driving
  - System uncertainties and limits
- Impact of system failures



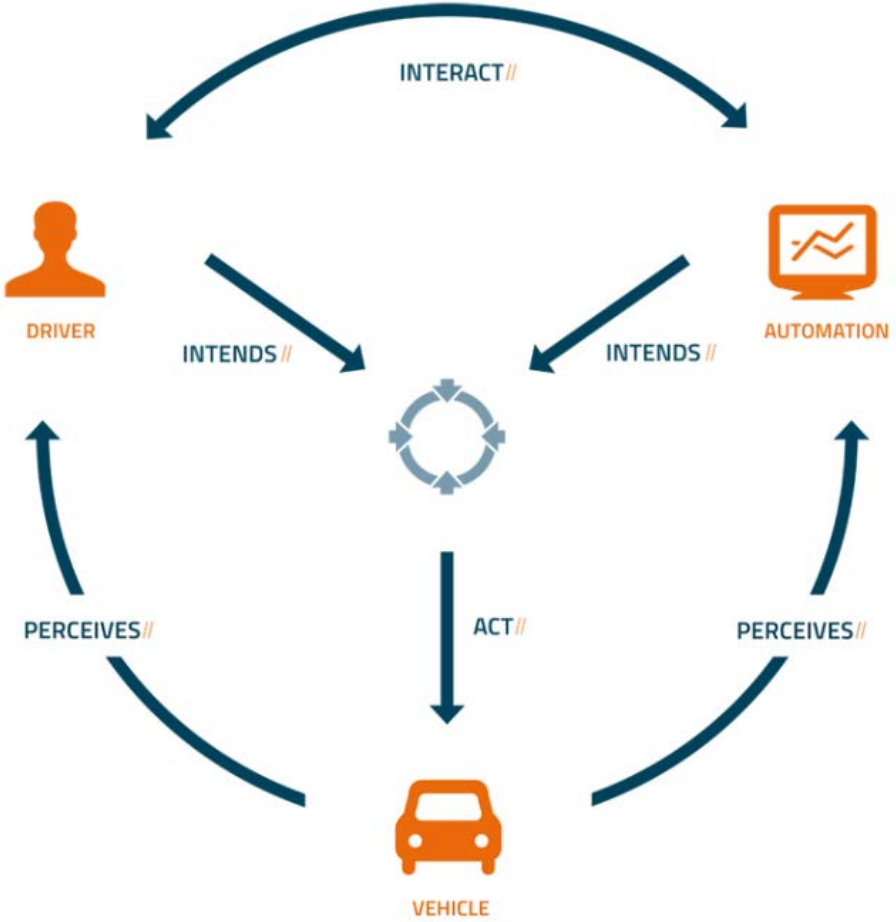
// Research activity

- A total of 17 experiments were conducted
  - Surveys
  - Simulator studies
  - Field studies
- More than 300 drivers and 2700 participants

- Results from the 1st Round of Experiments

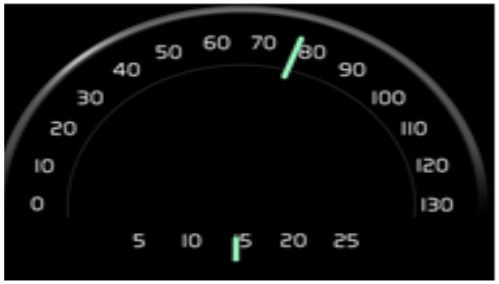


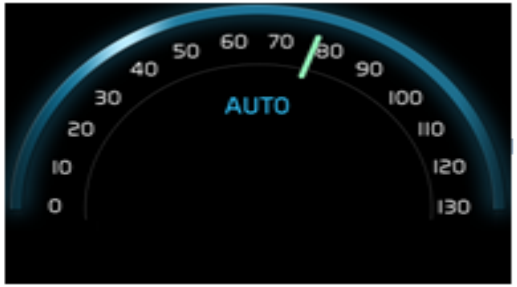


VOLVO

- How many automation levels should be displayed to the driver?



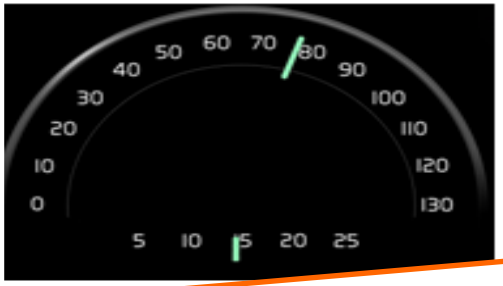


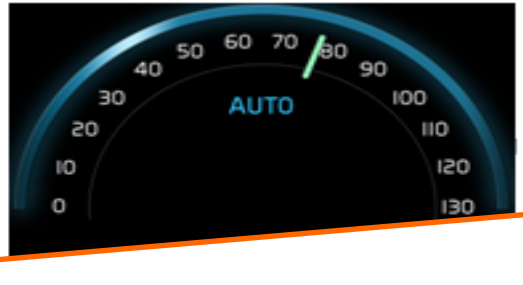
Two-mode interface

Three-mode interface

Conclusions:

- Driver showed preference for the two-mode interface
- High traffic density: Shorter time to hands on steering wheel
- After automation failure: Shorter Time to button press and time to hands on in the two-mode design





Two

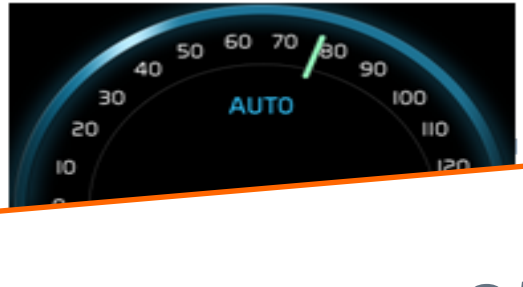
face

Conc

- Dr
- Hig
- Aft shorter Time to button press and time to hands on in the two-mode design

HUMAN FACTORS RECOMMENDATION

AVAILABLE AUTOMATION LEVELS SHOULD BE RESTRICTED TO THE MINIMUM POSSIBLE NUMBER



Two

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Conc

- Dr
- Hig
- Aft shorter Time to button press and time to hands on in the two-mode design

HUMAN FACTORS RECOMMENDATION

USE ADDITIONAL CUES SUCH AS SOUND AND HAPTIC CUES TO INDICATE MODE CHANGES.

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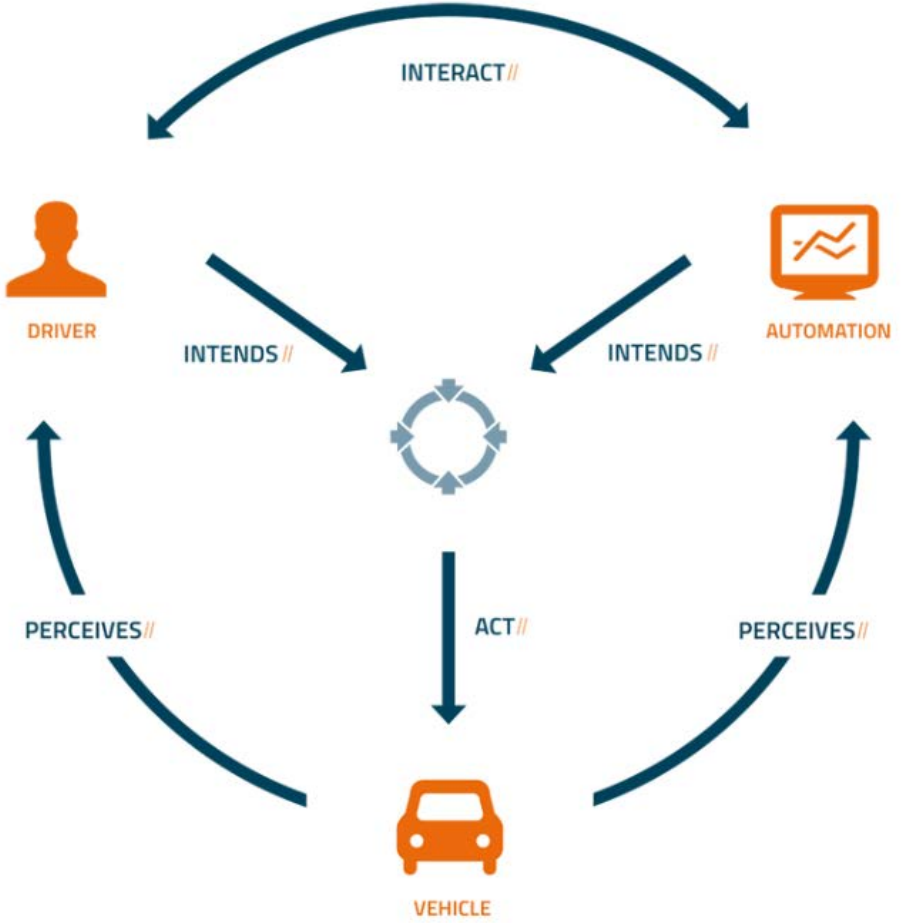


- How to take drivers "out of the loop"?
- How does being out of the loop affect the ability to resume control and respond in dangerous situations?

// Leeds

Conclusions:

- Manipulation by fog is a good way to take drivers “out of the loop”
- More collisions when drivers were out of the loop

HUMAN FACTORS RECOMMENDATION

THE AUTOMATION SHOULD BE ABLE TO VERIFY THE LEVEL OF ALERTNESS AND TASK-ORIENTED ATTENTION OF THE DRIVER

Conclu

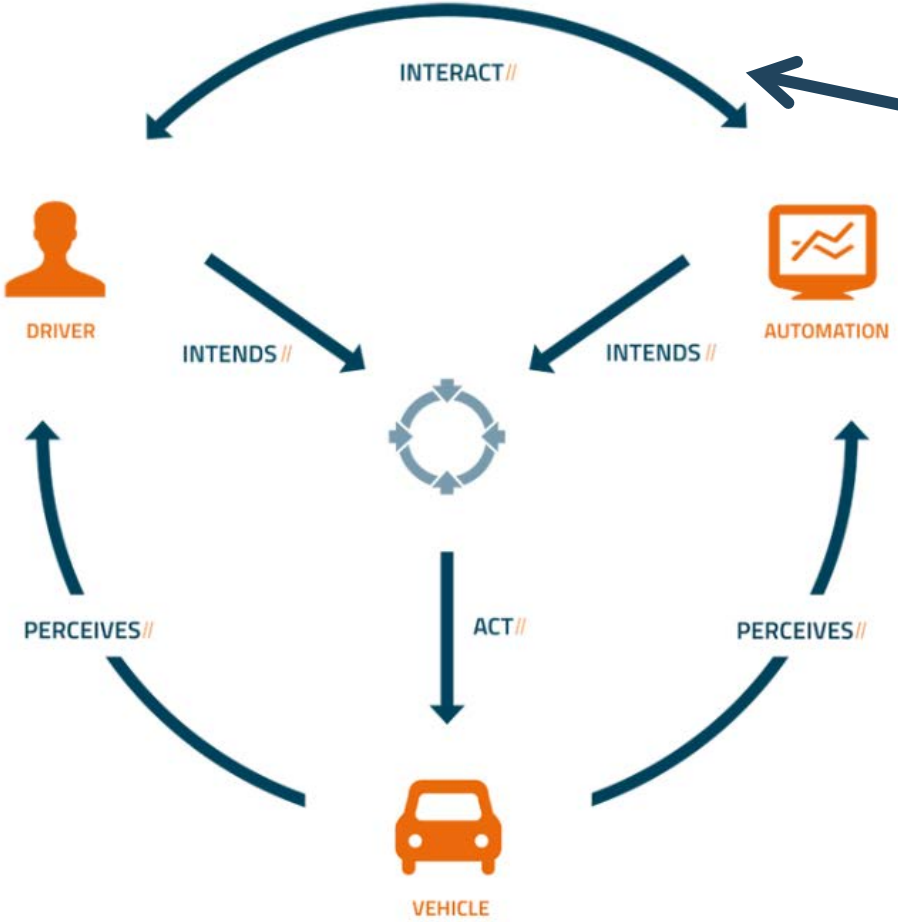
- Manipulation by fog is a good way to take drivers “out of the loop”
- More collisions when drivers were out of the loop

HUMAN FACTORS RECOMMENDATION

IF AVAILABLE, USE VISUAL FEEDBACK E.G. A FLASHING STEERING WHEEL SYMBOL TO INDICATE SYSTEM UNCERTAINTY

Conclu

- Manipulation by fog is a good way to take drivers “out of the loop”
- More collisions when drivers were out of the loop



- What kind of parking HMI do users prefer?

Ford

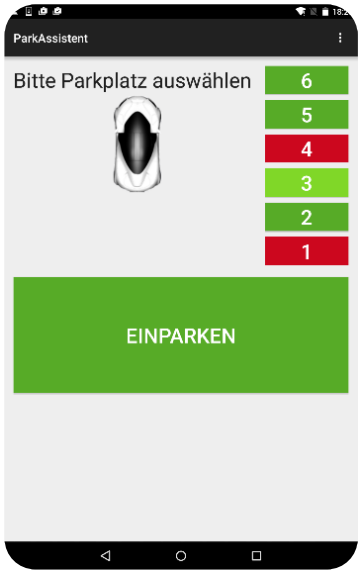
Smartphone app for parking automation

- What kind of parking HMI do users prefer?
  - Is there a difference between a short press versus a permanent interaction solution?

Conclusions:

- No significant difference between short and permanent HMI mode for handling of critical events

Permanent interaction



Short press

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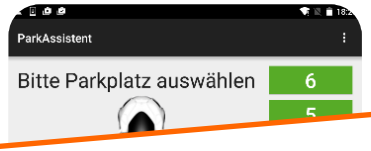
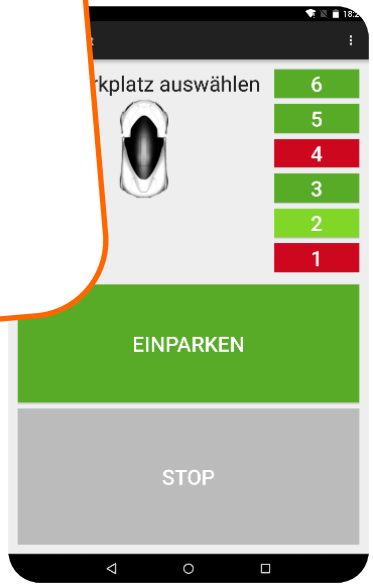
Smartphone app for parking automation

- What kind of parking HMI do users prefer?
  - Is the

Permanent interaction



Short press



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HUMAN FACTORS RECOMMENDATION

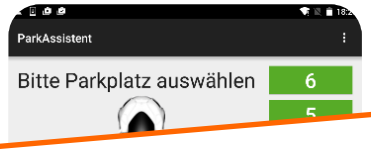
SMARTPHONE APP WELL ACCEPTED FOR PARKING AUTOMATION

// Ford

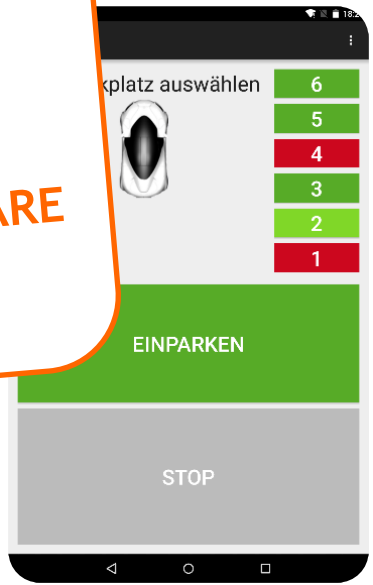
Smartphone app for parking automation

- What kind of parking HMI do users prefer?
  - Is the

Permanent interaction



Short press



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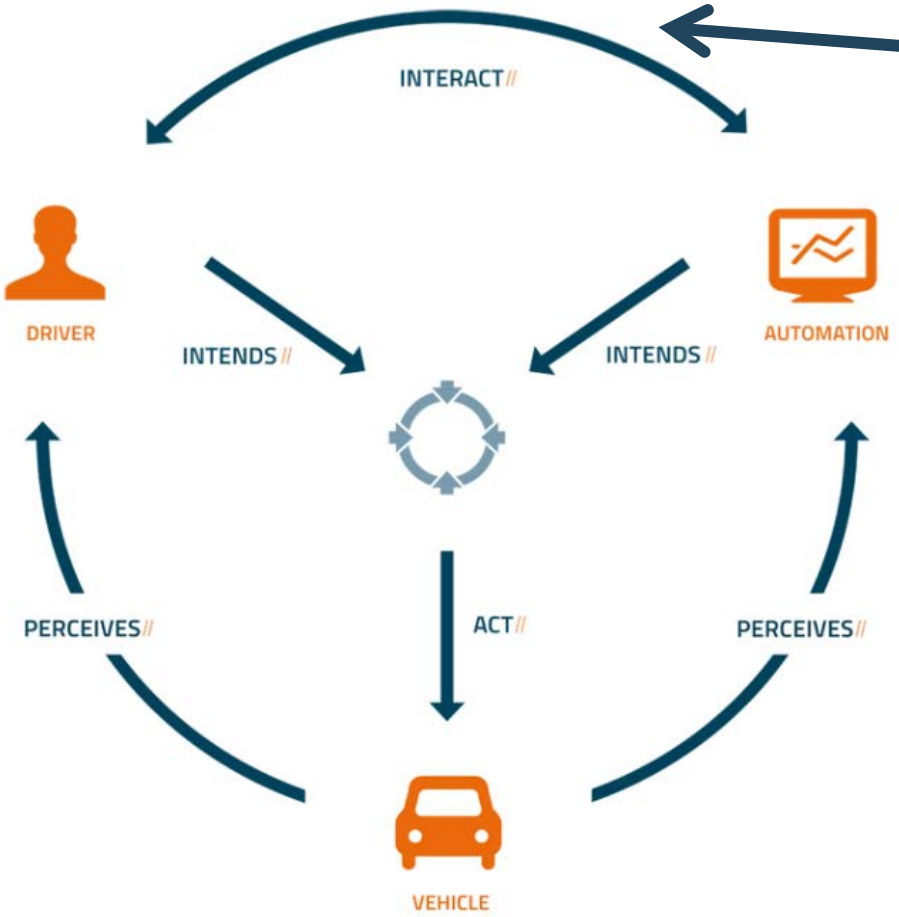
HUMAN FACTORS RECOMMENDATION

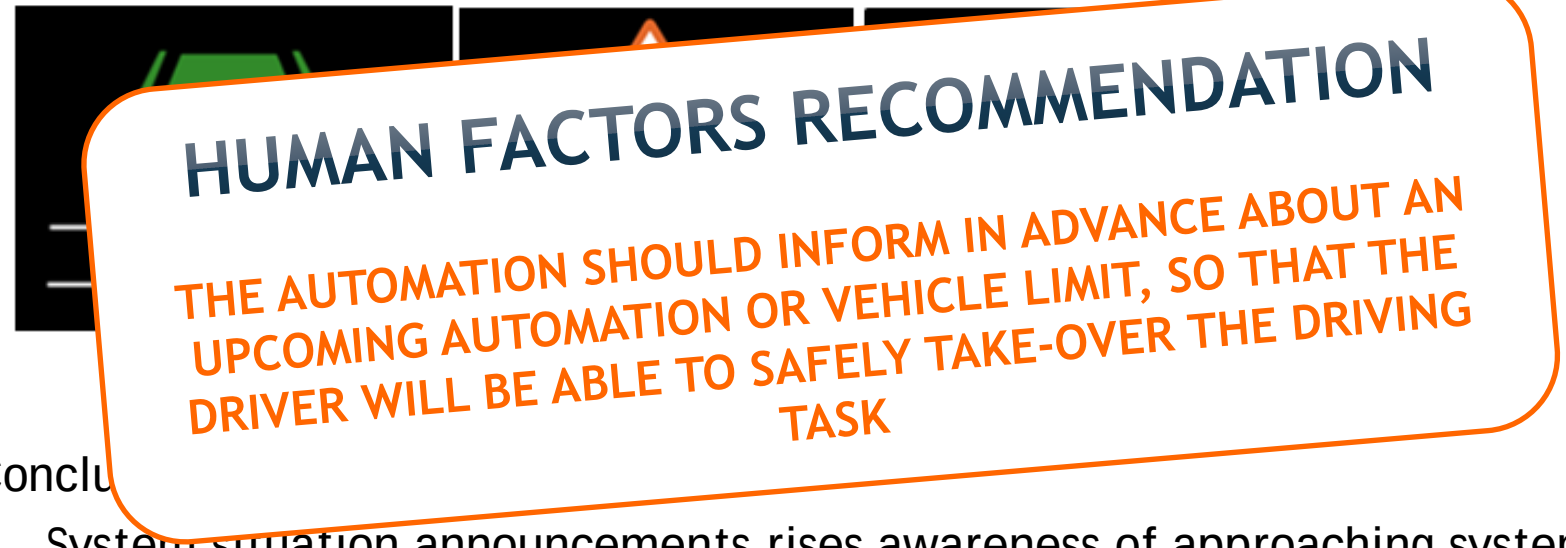
SHORT PRESS AND PERMANENT INTERACTION HMI MODES ARE BOTH POSSIBLE



- How does a timely announcement of a traffic situation influence driving behavior at take-over situations

Conclusion:

- System situation announcements rises awareness of approaching system limits
- Help to avoid uncomfortable transitions.



HUMAN FACTORS RECOMMENDATION

THE AUTOMATION SHOULD INFORM IN ADVANCE ABOUT AN UPCOMING AUTOMATION OR VEHICLE LIMIT, SO THAT THE DRIVER WILL BE ABLE TO SAFELY TAKE-OVER THE DRIVING TASK

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- System situation announcements rises awareness of approaching system limits
- Help to avoid uncomfortable transitions.

Conclu

- System situation announcements rises awareness of approaching system limits
- Help to avoid uncomfortable transitions.

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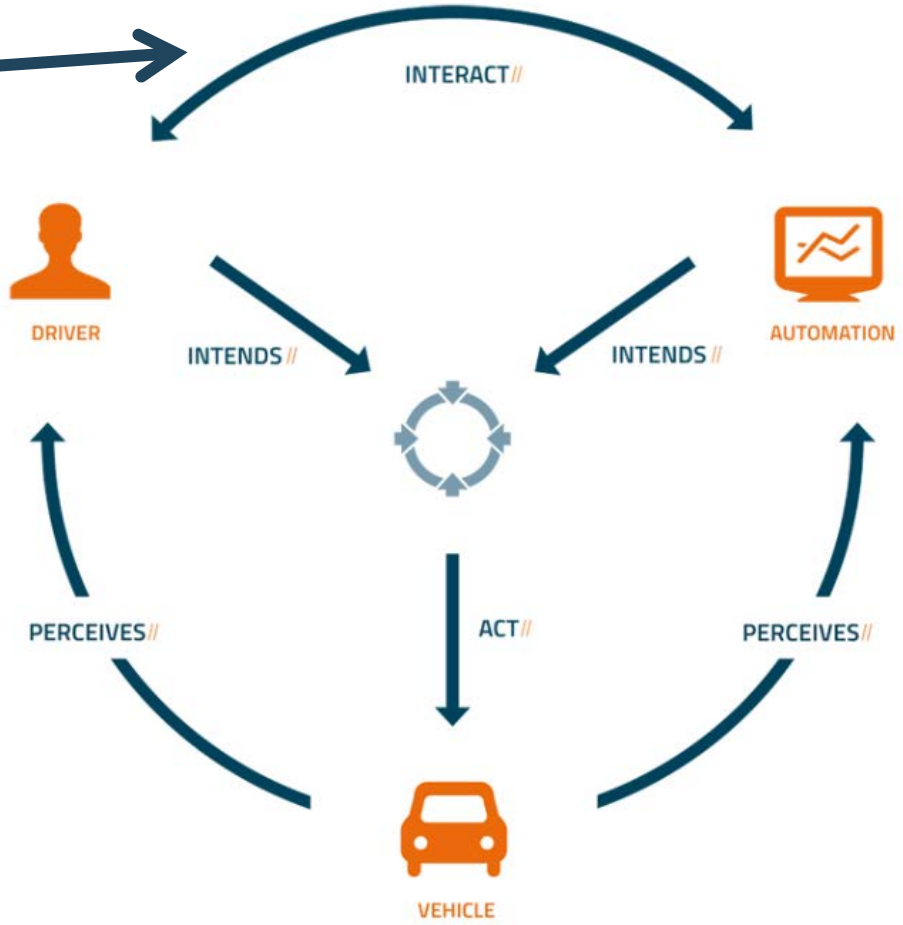
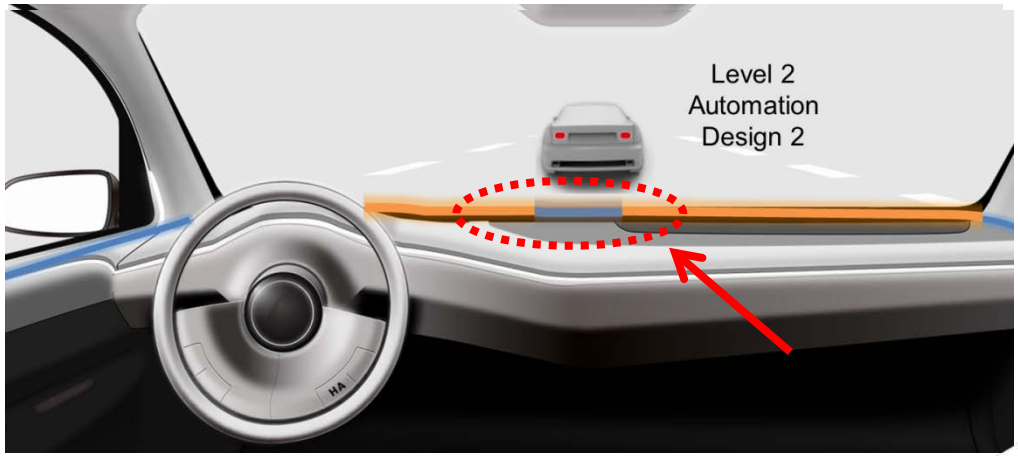
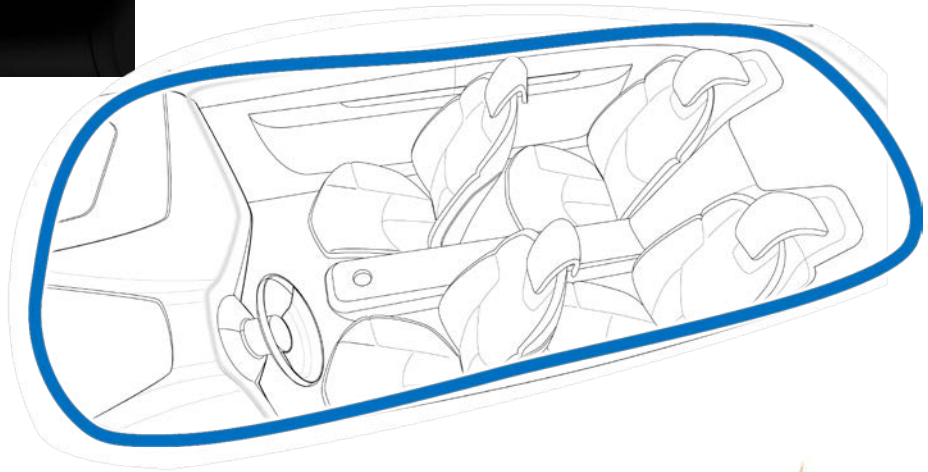


- How to bring the driver from level 3 into level 2 with peripheral cues
- How to help drivers to anticipate automation behavior and failures?


Level 2
Automation
Design 2




Level 3
Automation
Level 2
Automation
Design 2
Level 2
Automation
Design 1

- Peripheral vision is very effective for brining driver back into supervising task
- Indication detected vehicles help drivers to anticipate future maneuvers of the automation
- Indication detected vehicles supports drivers in anticipating automation failures

- Per
  bac
- Ind
  futu
- Indi
  anticipating automation failures

HUMAN FACTORS RECOMMENDATION

IF AVAILABLE, USE PERIPHERAL VISUAL FEEDBACK TO COMMUNICATE WARNINGS, RECOMMENDATIONS, UNCERTAINTIES AND AUTOMATION LEVELS.

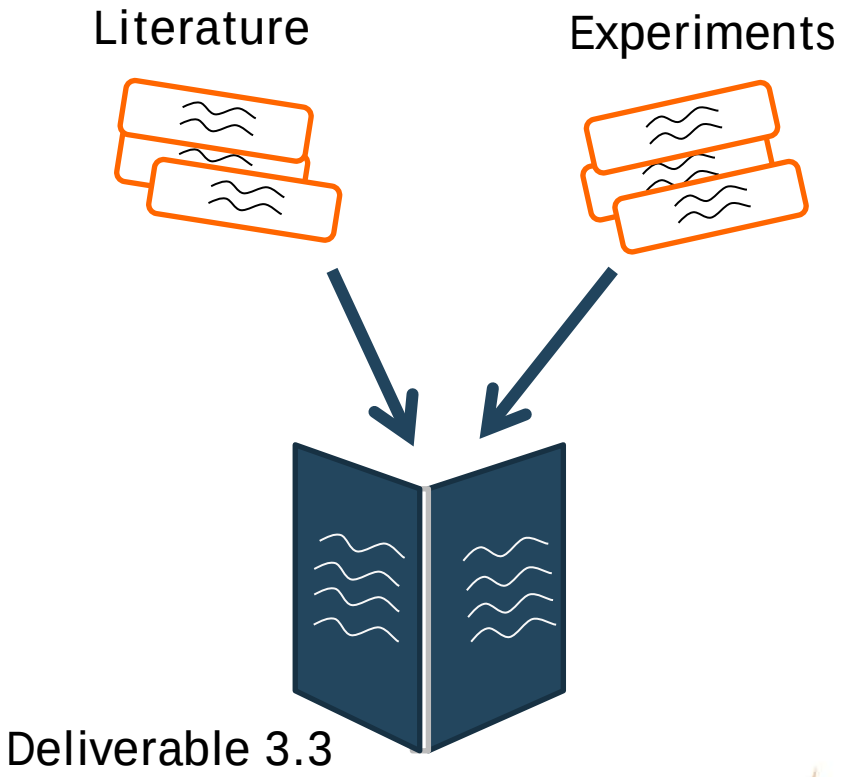
- Per
  bac
- Ind
  futu
- Indi
  anticipating automation failures

HUMAN FACTORS RECOMMENDATION

USE AN 360° AMBIENT DISPLAY FOR INDICATING DETECTED VEHICLES TO SUPPORT DRIVERS IN ANTICIPATING AUTOMATION MANEUVERS AND FAILURES

// Implications for Demo Vehicles: Functional Recommendations

- "D3.3 - Final functional HF recommendations"
  - under development
  - will be finalized in May 2017



AdaptIVe Final Event

See you in **Aachen, Germany,**
at the Final Event on **June 28 & 29, 2017.**

- Please visit www.AdaptIVe-ip.eu for more information coming up soon!

Co-funded by
the European Union

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Technologies for Intelligent Vehicles

Thank you.

Marc Dziennus
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// Publications

- Dziennus, M., Kelsch, J., Schieben, A. (2016), Ambient light based interaction concept for an integrative driver assistance system – a driving simulator study. In D. de Waard, K.A. Brookhuis, A. Toffetti, A. Stuiver, C. Weikert, D. Coelho, D. Manzey, A.B. Ünal, S. Röttger, and N. Merat (Eds.). Proceedings of the Human Factors and Ergonomics Society Europe Chapter 2015 Annual Conference (pp. 171-182). Downloaded from http://hfes-europe.org (ISSN 2333-4959)